IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of	
David BRADY, et al.	Art Unit: 2622
Serial No. 10/784,472	Examiner: Usman A. Khan
Filed: February 24, 2004	*Confirmation No. 1758*
For: FOCAL PLANE CODING FOR DIGITAL IMAGING	Attorney Docket No. 280/102

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

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Sir:

INTRODUCTORY COMMENTS

Pursuant to the Appellant's earlier filed Notice of Appeal on July 22, 2011, and further to the Notice of Panel Decision from Pre-Appeal Brief Review mailed August 12, 2011, Appellant hereby appeals to the Board of Patent Appeals and Interferences from the final rejection mailed February 22, 2011. A Petition for a Two Month Extension of time to November 22, 2011 is filed concurrently herewith. Thus, the Appeal Brief is timely filed. Appellant submits this Appeal Brief along with the filing fee of $540.00 set forth in 37 C.F.R. §41.20(b)(2).

Also enclosed is a Claims Appendix in compliance with 37 C.F.R. § 41.37(c)(1)(viii). An Evidence Appendix in compliance with 37 C.F.R. § 41.37(c)(1)(ix) is enclosed and indicated as being NONE. A Related Proceedings Appendix in compliance with 37 C.F.R. § 41.37(c)(1)(x) is enclosed and indicated as being NONE.

I. Real Party in Interest

Due to the assignment executed on June 24, 2004, July 23, 2004, and June 24, 2004, respectively by the inventors David BRADY, Michael FELDMAN, and Nikos PITSIANIS, recorded in the U.S. Patent and Trademark Office on October 21, 2010, at Reel 025207, Frame 0650; the Change of Name executed on March 30, 2007, recorded in the U.S. Patent and Trademark Office on January 12, 2011, at Reel 025651, Frame 0206; and the Change of Name executed on July 1, 2011, recorded in the U.S. Patent and Trademark Office on November 21, 2011, at Reel 027262, Frame 0380, the real parties in interest are as follows:

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And

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II. Related Appeal and Interferences

Although the real party in interest has other appeals and interferences, none of the other pending appeals and interferences is believed to directly affect or be directly affected by, or have any bearing upon, the decision of the Board of Patent Appeals and Interferences in this appeal.

III. Status of Claims

The status of the claims of the application is as follows:

Claims 1-40: rejected.

IV. Status of Amendments

Claims 1-40 were rejected in the Office Action Made Final mailed February 22, 2011.

Accordingly, there are currently no outstanding issues regarding the status of amendments. Claims 1-40 are currently pending in the subject application. Claims 1, 12, and 30 are independent.

A copy of the claims involved in the appeal is included in the Claims Appendix.

V. Summary of the Claimed Subject Matter

Embodiments relate to a multiple aperture imaging system 10, wherein each aperture or micro-camera includes an imaging lens 12, a focal plane coding element 14, and a detector plane including a plurality of pixels.[1] Embodiments are further directed to compressive coding using focal plane coding elements that allow reconstruction of images having a higher spatial resolution than the number of detector elements on the focal plane of an imaging system.[2] These focal plane coding elements provide sub-pixel shifting of an image on an individual detector.[3] An example of a focal plane coding element 14 is illustrated in FIG. 2, in which optical resolution elements 42 are arranged in varying patterns 40.[4] Each pixel in a given micro-camera may have the same sub-pattern.[5] Thus, focal plane coding may used to provide a reconstruction image having a spatial resolution that is higher than the nominal spatial resolution of the electronic focal plane.[6]

VI. Grounds of Rejection to be Reviewed

Claims 30, 31, 33, and 34 stand rejected under 35 U.S.C. § 103(a) as being unpatentable U.S. Patent No. 7,009,652 to Tanida et al. ("the Tanida et al. reference") in view of U.S. Patent No. 5,355,222 to Heller et al. ("the Heller et al. reference")

Claim 32 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the Tanida et al. reference in view of the Heller et al. reference, and further in view of Examiner's Official Notice.

Claims 1-4, 6, 9-13, 15-19, 21-29, 36, 37, 39, and 40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the Tanida et al. reference in view of U.S. Patent No. 7,003,177 to Mendlovic et al. ("the Mendlovic et al. reference"), and further in view of the Heller et al. reference.

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[1] See application as filed, FIG. 1, paragraphs [0014] and [0019].
[2] *Id.*, paragraphs [0024] and [0037].
[3] *Id.*, paragraphs [0029] and [0034].
[4] *Id.*, paragraphs [0030-31].
[5] *Id.*
[6] *Id.*, paragraph [0040].

Claim 5 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the Tanida et al. reference in view of the Mendlovic et al. reference in view of the Heller et al. reference, and further in view of U.S. Patent No. 6,366,319 to Bills ("the Bills reference").

Claims 7 and 14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the Tanida et al. reference in view of the Mendlovic et al. reference in view of the Heller et al. reference, and further in view of U.S. Patent No. 6,137,535 to Meyers ("the Meyers reference").

Claims 8, 20, 35, and 38 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the Tanida et al. reference in view of the Mendlovic et al. reference in view of the Heller et al. reference, and further in view of Examiner's Official Notice.

Thus, each claim stands finally rejected under 35 U.S.C. § 103(a).

VII. Argument

i. Rejection of Claim 30

Claim 30 recites, in part, "each image blocking portion being smaller than a detector," "the plurality of multiple image blocking portions being between the lens and the plurality of detectors," and that "an output of the plurality of detectors for each lens together representing an input image multiplied by a selected transform matrix."

The Office action Made Final notes that the Tanida et al. reference fails to teach each image blocking portion being smaller than a detector, and relies on the Heller et al. reference as teaching that the pixels are sub-pixels.[7] The Applicant respectfully disagrees for at least the reasons set forth below.

a. References not properly combinable

It is submitted that these references are not properly combinable. The Tanida et al. reference is directed to an imaging apparatus, while the Heller et al. reference is directed to an optical position detecting device, i.e., the Heller et al. reference does **not image** anything, but merely detects presence or absence of light output from an optical transmitter attached to a moving object. The reasons for combining provided in the Office action regarding detection set forth in the Heller et al. reference would not apply to the imaging system as in

[7] Office Action made Final February 22, 2011, page 4, penultimate paragraph.

the Tanida et al. reference. One of skill in the art would not be motivated to combine teachings regarding such optical position detecting devices with imaging systems.

The Office Action made Final asserts that these references are analogous since the Heller et al. reference teaches "that a relatively small number of small sensors, having high signal sensitivity, may be used for area location to a certain degree of resolution" and that the invention in the Heller et al. reference compensates for perspective viewing.[8] While the Heller et al. reference may be directed to analyzing light, the Heller et al. reference is not directed to imaging light.[9] In particular, the Heller et al. reference is directed to determining a position of a moving target based on reflection of light output from a transmitter onto a detector array.[10] Improving the resolution of detection of a moving target in the Heller et al. reference is not reasonably pertinent to the particular problem of creating a compact, high resolution imager in the Tanida et al. reference. Therefore, it is submitted that these references are not analogous.

b. All elements not disclosed

Even assuming, *arguendo*, that the references may be combined, the combination still fails to suggest, much less disclose, all of the limitations of claim 30.

First, the Heller et al. reference discloses that apertures may be used to replace lenses in order to overcome complexity and accuracy issues associated with using lenses.[11] The Office Action made Final notes that the microlenses in the Tanida et al. reference are different from the lens noted as problematic in the Heller et al. reference.[12] However, the microlenses in the Tanida et al. reference exacerbate the problems noted in the Heller et al. reference, as microlenses are more complex and sensitive to alignment issues than individual lenses.

Second, the apertures in the Heller reference are in the aperture plane so that the field of view is limited for the corresponding sensor, i.e., each aperture corresponds to a single sensor in the Heller et al. reference. Therefore, the combination of the Heller et al. reference

[8] Id., page 2.
[9] Image- *Physics* An optically formed duplicate, counterpart, or other representative reproduction of an object. http://www.thefreedictionary.com/image.
[10] The Heller et al. reference, Abstract, col. 2, lines 61-68.
[11] The Heller et al. reference, col. 1, line 66 to col. 2, line 2.
[12] Office Action made Final mailed February 22, 2011, paragraph spanning pages 2-3.

and the Tanida et al. reference would replace each lens of the Tanida et al. reference with the apertures of the Heller et al. reference. Thus, a pattern of these apertures would not be "substantially the same for the plurality of detectors associated with a corresponding lens" as recited in claim 30.

Third, even if the apertures of the Heller et al. reference were used with the lenses in the Tanida et al. reference, there is no suggestion or teaching in the combination as to where to place the apertures relative to the lenses. In particular, as the aperture plane in the Tanida et al. reference is the lens plane[13], at most, one aperture would be placed on each lens, i.e., not between the lenses and the detectors, as recited in claim 30.[14] Such an arrangement would result in the aperture and, thus, the lens, being associated either with a single sensor *or* the aperture and, thus, the lens, being associated with the plurality of detectors, which would not provide sub-pixel resolution. Neither scenario would provide an image output by the plurality of detectors for that lens being multiplied by a transform matrix, as recited in claim 30.

Finally, even assuming a plurality of apertures of the Heller et al. reference are placed between each lens and corresponding detectors of the Tanida et al. reference such that an aperture corresponds to a single detector, there is no suggestion or teaching in the combination that a pattern of these apertures would be "substantially the same for the plurality of detectors associated with a corresponding lens" as recited in claim 30.

Therefore, it is submitted that neither the Tanida et al. reference nor the Heller et al. reference, either alone or in combination, suggest, much less disclose, all of the limitations recited in claim 30. Therefore, it is respectfully requested that this rejection be withdrawn.

ii. Rejection of Claims 1 and 12

Claims 1 and 12 recite, instead of image blocking portions that are smaller than a detector, focal plane coding elements for each detector, each having multiple sub-pixel resolution elements. Otherwise, claims 1 and 12 recite all of the limitations relied on above as distinguishing claim 30 from the combination of the Tanida and Heller et al. references. In particular, claims 1 and 12 recite that the focal plane coding elements are (1) between the

[13] The Tanida et al. reference, FIGS. 1 and 2.

[14] "the plurality of multiple image blocking portions being between the lens and the plurality of detectors"

lenses and the detectors, (2) have patterns that are substantially the same for the plurality of detectors associated with a corresponding lens, and (3) an output of the plurality of detectors for each lens together representing an input image multiplied by a selected transform matrix. The additional secondary reference, i.e., the Mendlovic et al. reference, fails to provide all of these missing teachings. In particular, even assuming that the pattern of slits of the Mendlovic et al. reference constitutes a pattern of sub-pixel resolution elements, each detector in the plurality of detectors would be imaging a different section of the pattern of slits, such that the pattern of the multiple sub-pixel resolution elements would **not** be substantially the same for the plurality of detectors associated with a corresponding lens, as recited in claims 1 and 12.

Therefore, it is respectfully submitted that this combination fails to suggest, much less disclose, all of the limitations recited in claims 1 and 12. It is respectfully requested that this rejection be withdrawn.

iii. Dependent Claims

The remaining secondary references fail to provide the teachings noted above as missing. The remaining dependent claims depend from various ones independent claims 1, 12, and 30. Therefore, all of the claims are believed to be allowable for at least the reasons set forth above, and it is requested that all rejection be reconsidered and withdrawn.

Conclusion

For at least the reasons set forth above, appellants respectfully submit that the applied references fail to suggest, much less disclose, each and every element of the independent claims. Accordingly, all of the pending claims are believed to be allowable.

In view of the above, appellants respectfully request that all grounds of rejection be overturned.

Respectfully submitted,
LEE & MORSE, P.C.

Date: November 22, 2011

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ATTACHMENTS:

PETITION FOR TWO MONTH EXTENSION
NOTICE OF APPEAL

PETITION and
DEPOSIT ACCOUNT CHARGE AUTHORIZATION

This document and any concurrently filed papers are believed to be timely. Should any extension of the term be required, applicant hereby petitions the Director for such extension and requests that any applicable petition fee be charged to Deposit Account No. 50-1645.

If fee payment is enclosed, this amount is believed to be correct. However, the Director is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 50-1645.

Any additional fee(s) necessary to effect the proper and timely filing of the accompanying-papers may also be charged to Deposit Account No. 50-1645.

VIII. CLAIMS APPENDIX

The pending claims as they stand on appeal are presented in a listing of the claims, below. Claims 1-40 are currently pending in the subject application. Claims 1, 12, and 30 are independent.

Listing of Claims:

1. (Previously Presented) An imaging system, comprising:

an array of lenses;

a plurality of detectors for each lens, the detectors being on an image plane of the imaging system; and

a corresponding plurality of focal plane coding elements, a focal plane coding element provided for each detector, each focal plane coding element having multiple sub-pixel resolution elements, each sub-pixel resolution element being smaller than a detector, a pattern of the multiple sub-pixels resolution elements being substantially the same for the plurality of detectors associated with a corresponding lens, the plurality of focal plane coding elements being between the lens and the plurality of detectors, wherein at least two of the focal plane coding elements provided for the plurality of detectors associated with different lenses have different patterns of multiple sub-pixel resolution elements, an output of the plurality of detectors for each lens together representing an input image multiplied by a selected transform matrix.

2. (Original) The imaging system as recited in claim 1, wherein the focal plane coding element provides sub-pixel shifted multiple images on each sensor pixel.

3. (Original) The imaging system as recited in claim 1, wherein the focal plane coding element is an apertured mask.

4. (Original) The imaging system as recited in claim 1, further comprising color filters.

5. (Previously Presented) The imaging system as recited in claim 4, wherein the color filters are the sub-pixel resolution elements.

6. (Original) The imaging system as recited in claim 1, further comprising a birefringent structure adjacent the focal plane coding element.

7. (Original) The imaging system as recited in claim 1, further comprising a corresponding plurality of focusing lenses, a focusing lens between the focal plane encoding element and a corresponding sensor pixel.

8. (Original) The imaging system as recited in claim 1, wherein the selected transform matrix has fewer rows than columns.

9. (Original) The imaging system as recited in claim 1, wherein at least one sensor pixel receives light from more than one lens of the array of lenses.

10. (Original) The imaging system as recited in claim 1, further comprising a processor receiving the outputs of the sensor pixels and multiplying the outputs by an inverse of the selected transform matrix.

11. (Original) The imaging system as recited in claim 10, wherein the processor reconstructs an image from the outputs, a number of image pixels in the image being greater than the plurality of sensor pixels.

12. (Previously Presented) An imaging system, comprising:

an array of lenses;

a plurality of detectors for each lens;

a corresponding plurality of detectors, a filter provided for each detector, each filter having multiple sub-pixel resolution elements, each sub-pixel resolution element being smaller than a detector, a pattern of the multiple sub-pixels resolution elements being substantially the same for the plurality of detectors associated with a corresponding lens, and providing a sub-pixel shifted multiple image on each sensor pixel, the filter being between the lens and the plurality of detectors; and

a processor receiving outputs from each detector, the plurality of detector for each lens together representing an input image multiplied by a selected transform matrix, and reconstructing an image, a number of image pixels in the image being greater than the plurality of detectors.

13. (Previously Presented) The imaging system as recited in claim 12, further comprising a birefringent structure adjacent the plurality of filters.

14. (Original) The imaging system as recited in claim 12, further comprising a corresponding plurality of focusing lenses, a focusing lens between the filter and a corresponding sensor pixel.

15. (Original) The imaging system as recited in claim 12, wherein at least one sensor pixel receives light from more than one lens of the array of lenses.

16. (Original) The imaging system as recited in claim 12, wherein the filter is an apertured mask.

17. (Previously Presented) The imaging system as recited in claim 1, wherein the focal plane coding element is closer to the plurality of sensor pixels than to the array of lenses.

18. (Previously Presented) The imaging system as recited in claim 12, wherein the filter is closer to the plurality of sensor pixels than to the array of lenses.

19. (Previously Presented) The imaging system as recited in claim 18, wherein the filter is closer to the plurality of sensor pixels than to the array of lenses.

20. (Previously Presented) The imaging system as recited in claim 12, wherein the selected transform matrix has fewer rows than columns.

21. (Previously Presented) The imaging system as recited in claim 1, wherein a majority of patterns of multiple sub-pixel resolution elements are different from one another.

22. (Previously Presented) The imaging system as recited in claim 1, wherein a majority of patterns of multiple sub-pixel resolution elements block substantially half of incident light.

23. (Previously Presented) The imaging system as recited in claim 1, wherein each pattern of multiple sub-pixel resolution elements includes a plurality of apertures.

24. (Previously Presented) The imaging system as recited in claim 1, wherein at least one pattern of multiple sub-pixel resolution elements transmits substantially all incident light.

25. (Previously Presented) The imaging system as recited in claim 12, wherein a majority of patterns of multiple sub-pixel resolution elements are different from one another.

26. (Previously Presented) The imaging system as recited in claim 12, wherein a majority of patterns of multiple sub-pixel resolution elements block substantially half of incident light.

27. (Previously Presented) The imaging system as recited in claim 12, wherein each pattern of multiple sub-pixel resolution elements includes a plurality of apertures.

28. (Previously Presented) The imaging system as recited in claim 12, wherein at least one pattern of multiple sub-pixel resolution elements transmits substantially all incident light.

29. (Previously Presented) The imaging system as recited in claim 12, wherein color filters serve as sub-pixel resolution elements.

30. (Previously Presented) An imaging system, comprising:

an array of lenses;

a plurality of detectors for each lens, the detectors being on an image plane of the imaging system; and

a corresponding plurality of multiple image blocking portions provided for each detector, each image blocking portion being smaller than a detector, a pattern of multiple image blocking portions being substantially the same for the plurality of detectors associated with a corresponding lens, the plurality of multiple image blocking portions being between the lens and the plurality of detectors, wherein at least two patterns of multiple image blocking portions associated with different lenses are different, an output of the plurality of

detectors for each lens together representing an input image multiplied by a selected transform matrix.

31. (Previously Presented) The imaging system as recited in claim 30, wherein one lens of the array of lenses has no multiple image blocking portions associated therewith.

32. (Previously Presented) The imaging system as recited in claim 30, wherein the selected transform matrix is a Hadamard matrix.

33. (Previously Presented) The imaging system as recited in claim 30, wherein each image blocking portion is smaller than a detector in both directions.

34. (Previously Presented) The imaging system as recited in claim 33, wherein each image blocking portion in a pattern has equal dimensions in both directions.

35. (Previously Presented) The imaging system as recited in claim 1, wherein the selected transform matrix is a Hadamard matrix.

36. (Previously Presented) The imaging system as recited in claim 1, wherein each image blocking portion is smaller than a detector in both directions.

37. (Previously Presented) The imaging system as recited in claim 36, wherein each image blocking portion in a pattern has equal dimensions in both directions.

38. (Previously Presented) The imaging system as recited in claim 12, wherein the selected transform matrix is a Hadamard matrix.

39. (Previously Presented) The imaging system as recited in claim 12, wherein each image blocking portion is smaller than a detector in both directions.

40. (Previously Presented) The imaging system as recited in claim 39, wherein each image blocking portion in a pattern has equal dimensions in both directions.

IX. EVIDENCE APPENDIX

NONE

X. RELATED PROCEEDINGS APPENDIX

NONE